rotation of the disk interrupted what was then an invisible beam, which passed over a space of about twelve feet before it reached the lens which finally concentrated it upon the selenium cell. A faint but perfectly perceptible musical tone was heard from the telephone connected with the selenium. This could be interrupted at will by placing the hand in the path of the invisible beam. It would be premature, without further experiments, to speculate too much concerning the nature of these invisible rays; but it is difficult to believe that they can be bent rays, as the effect is produced through two sheets of hard rubber containing between them a saturated solution of alum. Although effects are produced as above shown by forms of radiant energy which are invisible, we have named the apparatus for the production and reproduction of sound in this way "the photophone," because an ordinary beam of light contains the rays which are operative.

It is a well-known fact that the molecular disturbance produced in a mass of iron by the magnetising influence of intermittent electrical current can be observed as sound by placing the ear in close contact with the iron. It occurred to us that the molecular disturbance produced in crystalline selenium by the action of an intermittent beam of light should be audible in a similar manner without the aid of a telephone or battery. Many experiments were made to verify this theory without definite results. The anomalous behaviour of the hard rubber screen suggested the thought of listening to it also. This experiment was tried with extraordinary success. I held the sheet in close contact with my ear, while a beam of intermittent light was focussed upon it by a lens. A distinct musical note was immediately heard. We found the effect intensified by arranging the sheet of hard rubber as a diaphragm, and listening through a hearing-tube. We then tried the crystalline selenium in the form of a thin disk, and obtained a similar, but less intense effect. The other substances which I enumerated at the beginning of my address were now successively tried in the form of thin disks, and sounds were obtained from all but carbon and thin glass. We found hard rubber to produce a louder sound than any other substance we tried, excepting antimony, and paper and mica to produce the weakest sounds. On the whole we feel warranted in announcing as our conclusion that sounds can be produced by the action of a variable light from substances of all kinds, when in the form of thin diaphragms. We have heard from interrupted sunlight very perceptible musical tones through tubes of ordinary vulcanised rubber, of brass, and of wood. These were all the materials at hand in tubular form, and we have had no opportunity since of extending these observations to other substances.

I am extremely glad that I have the opportunity of making the first publication of these researches before a scientific society, for it is from scientific men that my work of the last six years has received its earliest and kindest recognition. I gratefully remember the encouragement which I received from the late Prof. Henry at a time when the speaking telephone existed only in theory. Indeed, it is greatly due to the stimulus of his appreciation that the telephone became an accomplished fact. I cannot state too highly also the advantage I received in preliminary experiments on sound vibrations in this building from Prof. Cross, and near here from my valued friend Dr. Clarence J. Blake. When the public were incredulous of the possibility of electrical speech, the American Academy of Arts and Sciences, the Philosophical Society of Washington, and the Essex Institute of Salem, recognised the reality of the results and honoured me by their congratulations. The public interest, I think, was first awakened by the judgment of the very eminent scientific men before whom the telephone was exhibited in Philadelphia, and by the address of Sir William Thomson before the British Association for the Advancement of Science.

At a later period, when even practical telegraphists considered the telephone as a mere scientific toy, Prof. John Peirce, Prof. Eli W. Blake, Dr. Channing, Mr. Clarke, and Mr. Jones, of Providence, Rhode Island, devoted themselves to a series of experiments for the purpose of assisting me in making the telephone of practical utility; and they communicated to me from time to time the result of their experiments with a kindness and generosity I can never forget. It is not only pleasant to remember these things, and to speak of them, but it is a duty to repeat them, as they give a practical refutation to the often repeated stories of the blindness of scientific men to unaccredited novelties, and of their jealousy of unknown inventors who dare to enter the charmed circle of science. I trust that the scientific favour which was so readily accorded to the telephone may be extended by you to this new claimant—the photophone.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science*, July, contains—F. M. Balfour, on the structure and homologies of the germinal layers of the embryo (with woodcuts).—On Hubrecht's researches on the nervous system of nemertines (with a plate) abstract of.—A. G. Bourne, on the structure of the nephridia of the medicinal leech (with two plates).—Prof. Ray Lankester, on intra-epithelial capillaries in the integument of the medicinal leech (with a plate); and on the connective and vasifactive tissues of the same (with two plates).—Dr. H. Gibbes, on the use of the Wenham binocular with high powers.—On the structure of the spermatozoon.—P. H. Carpenter, on some disputed points in Echinoderm morphology.—Prof. Pouchet, on the origin of the red-blood corpuscles (translated from the *Revue Scientifique*).—Prof. Ray Lankester, on *Limnocodium sowerbii*, a new trachomedusa inhabiting fresh water (with woodcuts and two plates) [for an abstract *vide* NATURE, vol. xxii. p. 147].—Notes and memoranda.—*Proceedings* of the Dublin Microscopical Club for November and December, 1879.

Revue d'Anthropologie, tome iii. fascic. 3 (July).—Prof. J. Delbos, of Nancy, gives a brief report of the discovery, made in 1869, of a number of human skeletons in the loam beds of Bollwiller (Haut-Rhin). His paper, which describes the general geognostic character of the soil in which these remains were found, is followed by a detailed description, by Dr. René Collignow, of each of the seven distinct skeletons that have been recovered. Of these, five were adult males, two females, and one a child of about seven. In general characteristics they resemble the Cannstatt remains.—Dr. Bérenger-Féraud, whose position in Senegal as Médecin-en-chef de la Marine gave him favourable opportunities of studying the habits of the natives, has drawn up an interesting report of all that is known on the spot in regard to the mysterious sect of the Simos, which exercises an important influence on the tribes of the west coasts of Africa, from Cape Vert as far as the Gabon settlements on the equator. The Simo of these regions is the dreaded Mombo-Yombo of other races.—Dr. Gustave Lagneau's paper, "De quelques Dates reculées," is a scholarly dissertation on the community of race traceable in the Belgæ, Galli, and Germani, and on the evidence supplied in reference to the period of their immigration into Keltic lands by the introduction of a dolichocephalic character, in addition to the purely brachycephalic type observable in the skulls of Keltic and Kimmerian races. In discussing the question of the occupation of Western Europe by Iberians, M. Lagneau enters at length into the historical and anthropological grounds for accepting the testimony of Plato and others as to the defeat of those tribes by a powerful race, the Atlantæ, and the existence of a great western continent, or archipelago, the submerged Atlantis, from which the latter peoples made their inroads on West Africa and West Europe.—M. Martinet's enumeration of the prehistoric monuments of Berry deserves special notice for the interesting information it supplies in reference to the so-called "Mardelles," a kind of conically shaped excavations, the purport of which has not been determined, and which, although found elsewhere, as in Normandy, Provence, &c., is of exceptional frequency in Berry, where between 300 and 400 have been explored. In diameter they vary from 20 to 100 metres, in depth from 50 centimetres to 8 metres. Traces of ashes, calcined animal bones, and coarse potsherds, with a few broken flints, have been found at the bottom of these depressions, of which several are generally ranged in a line near natural or artifically constructed caverns.

Journal de Physique, August.—Experimental researches on rotatory polarisation in gases, by M. H. Becquerel.—Magnetic rotatory power of liquids and of their vapours, by M. Bichat.—Experiments on flames, by M. Neyreneuf.

Journal of the Franklin Institute, August.—The limitations of the steam-engine, by W. D. Marks.—Economical cut-off in steam-engines, by S. W. Robinson.—The involute of the circumference of a circle, by J. J. Skinner.—Holman's new compressorium and moist chamber, by J. A. Ryder.

Rivista Scientifico-Industriale, No. 15, August 15.—Periodic spontaneous movement of the stamens of *Ruta bracteosa*, D.C., and of *Smyrnum rotundifolium*, by Dr. Macchiati.—Synthesis of meteorological observations in Modica and Syracuse on the fall of meteoric powders, from the end of 1876 to April 16, 1880, by Prof. Lancetta.

No. 16, August 31.—On types of rocks, by Prof. de Stefani.

—New apparatus for the electric light.—Parallelogram of forces, by Prof. Lancetta.—Further contributions to the Aphides of Sardinia; description of three new species, by Prof. Macchiati.

Atti della R. Accademia dei Lincei, June.—On an apparatus for determining the mechanical equivalent of heat, by Dr. Bartoli.—On the laws of galvanic polarisation, by the same.—On a human skeleton of the age of stone in the Roman province, by Dr. Incoronato.—Liassic limestone of Gozzano, and its fossils, by Dr. Parona.—Works on the Tiber, and varied conditions of the Roman land, by S. Ponzi.—Reply to S. Ferrari's observations (relating to anomalous induction of a magnetic declinometer), by Prof. Keller.—On the mechanism of movements of the iris, by S. Morizzia.—On some derivatives of natural and synthetic thymol, by Professors Paterno and Canzonesi.—Analysis of an augite of Lazio, by Dr. Piccini.—Chemical researches on the lava of Montecompatri, &c., by Dr. Mauro.—On the hæmatopoetic function, by SS. Tizzoni and Fileti.—On the diffusion of the metals of cerite, by S. Cossa.—On tungstate of didymium, by the same.— On a proposition of Jacobi, by S. Siacci.—On a class of differential equations integrable by elliptic functions, by S. Brioschi.—Verification and use of a new formula for calculation of planetary perturbations, by S. De Gasparis.

Rendiconto delle Sessioni dell'Accademia delle Scienze dell' Istituto di Bologna, 1879-80.—We note here the following:—On the placenta of cartilaginous fishes and mammalia, and its applications in zoological taxonomy and anthropogeny, by Prof. Ercolani.—Variations of human temperature resulting from bodily movements, by Prof. Villari.—Dimensions of the electric spark of condensers, by the same.—On variation of length due to magnetism, by Prof. Righi.—On some products of decomposition of albumen at the temperature of the human body, and at slightly lower temperatures, by Prof. Selmi.—On the singular verticillate configuration of laminæ of crystalline snow, &c., by Prof. Bombicci.—On a case of permanent polarity in a magnet opposite to that of the inducing helix, by Prof. Righi.—Laws relative to the dimensions of electric sparks of condensers, by Prof. Villari.—Investigation of phosphorus in the urine in cases of poisoning, and products which may occur, by Prof. Selmi.—A mercury pneumatic machine with double action, by S. Liuzzi.—Verification of ptomaines in most cases of chemico-legal investigation, and formation of some of them, of poisonous nature, in animal substances kept three years in spirits, by Prof. Gianetti.—On the principal changes in the course of the Po, and means of obviating disaster threatened by it, by Dr. Predieri.—On the intimate structure of the eyes of Diptera, and on the eyes of blind Talpa, by Prof. Ciaccio. (This *Rendiconto* contains a considerable number of papers relating to anatomy and local geology.)

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti. Vol. xiii., fasc. xv., July 15.—Outlines of a Government sanitary organisation, by Dr. Zucchi.—On the theory of hallucinations, by Prof. Tamburini.—Triassic fossils of the African Alps, by S. De Stefani.—The learned friends of Alexander Volta, by S. Z. Volta.

SOCIETIES AND ACADEMIES

LONDON

Entomological Society, September 1.—H. T. Stainton, F.R.S., vice-president, in the chair.—Miss Emily A. Smith, Assistant State Entomologist of Illinois, was elected a Foreign Member.—Mr. J. Jenner Weir exhibited specimens of *Odonestis potatoria* and *Smerinthus populi*, which possessed the peculiarities of both sexes.—Sir Sidney Saunders exhibited six winged examples of the Stylopideous genus *Hylecthrus*, and also various other Hymenoptera, and contributed remarks thereon.—Miss E. A. Ormerod exhibited some galls found on *Tanacetum vulgaris*, which she described at length.—Mr. T. R. Billups exhibited a female specimen of *Polyblastus whalbergi*, an ichneumon not previously recorded in Britain.—Mr. E. Boscher exhibited living specimens of the two varieties of the larvæ of *Smerinthus ocellatus*, and contributed a note thereon.—Mr. Meldola exhibited some specimens of *Camptogramma bilineata*, a large number of which had been found by Mr. English near Epping, attached firmly to the leaves of the "tea tree" (*Lycium barbarum*) by the abdomen, in which position they had died, possibly from the effects of a fungoid disease.—Mr. A. H. Swinton communicated a note on *Luciola italica*, an Italian fire-fly.

PARIS

Academy of Sciences, September 13.—M. Edm. Becquerel in the chair.—The following papers were read:—Observations of Faye's comet and of comet *b* 1880 (Schäberle) at Paris Observatory with the equatorial of the western tower, by M. Bigourdan.—On the probable orbital motion of some binary systems of the southern heavens, by M. Cruls. This is from the Imperial Observatory at Rio; and the author's data are compared with those of Sir J. Herschel at the Cape, and Capt. Jacob at Poonah.—Spectroscopic researches on some stars not hitherto studied, by M. Cruls. This relates to stars in the Bee, the Cross, and the Centaur.—On some solar phenomena observed at Nice, by M. Thollon. He gives several sketches of the spectral phenomena of protuberances, &c. He does not hesitate to say that every movement of the solar surface having, along the line of observation, a component which is not *nil*, causes a displacement of the spectral lines. It is also extremely probable, but not certain, that every displacement of a line corresponds to a movement.—On the law of electromagnetic machines (continued), by M. Joubert. With a given intensity of field, whatever the other conditions in which the machine works, from the moment when it gives maximum work, the retardation is equal to $\frac{1}{8}$ of the entire period; the intensity is constant and equal to the quotient by $\sqrt{2}$ of the absolute maximum of intensity; the electromagnetic work is proportional to the velocity; and the velocity is in a constant ratio to the resistance.—On boroduodecitungstic acid and its salts of potassium, by M. Klein.—On the subcutaneous lymphatics of the python of Séba, by M. Jourdain. The arrangement presents an evident similarity to that in Teleosteans (a ventral trunk and two lateral ones, &c.). When the direction of circulation of lymph has been ascertained, it will probably be found the same in both.—Deep dredging in the Lake of Tiberias (Syria), in May, 1880, by M. Lortet. The surface of the lake is 212 m. under that of the Mediterranean, but probably was at one time level with it; the greatest depth met with was about 250 m. at the northern extremity. It was thought that the waters, formerly saline, had probably contained special animal forms, traces of which might still be found at great depths. Some twelve species of fishes were met with, and some new forms. *Chromis* preponderated; indeed, they swarm in the lake. Twelve forms of mollusca were met with, some new species. The *Melanopsis* and *Melania* were of marine character. At the borders of the lake were some shrimps, crabs, and tortoises. Diatoms, foraminifera, &c., were obtained in the fine slime of the bottom, but no algæ or coniferæ were met with (the water indeed was brackish, and had a temperature of + 24°; that at the bottom was not more brackish than that at the surface).—On the existence in Soudan of wild vines with herbaceous stem, vigorous roots, and eatable fruit, by M. Lécard.—On a thunderstorm observed at Laigle (Orne) on August 6, 1880, by M. Royer. During an hour and a half he counted 4,700 flashes, or about 53 a minute. Sometimes there were 100 a minute. The storm lasted two hours in all. The lightning struck twice, viz., a house and a poplar-tree.

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